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An Introduction to Portable Video Systems  
c 1976

As an image and sound generating and recording tool, video has many varied applications. Videotapes may be made for instructional or documentary purposes, enabling the individual to produce and maintain a record of an event, to critically analyze and to study the event as recorded. Video may also be used within a performance activity, employing live cameras, prerecorded tapes and display systems involving a number of television sets as an integral part of the whole performance, adding interactive and sculptural components to the work and continuities and discontinuities of spatial and temporal structures. Video is also employed as an art medium with which to create visual works; the tools for such work include synthesizers, keyers, colorizers and digitizers. These works are developed in ways analagous to those used in electronic music composition. These artists are concerned with using the material of television, the image processing and synthesis systems, to compose video image structures and sequences. The works themselves may then be exhibited closedcircuit in galleries and museums and in certain cases are also broadcast.

A portable video system or portapack is capable of recording on videotape both video and audio information and playing back the tape so both picture and sound are displayed on a conventional television receiver. This single camera system consists of several main components, the camera and microphone for image and sound collection, the deck or videotape recorder for recording and playback of image and sound, a power system to operate camera, mike and deck and a television receiver for display.

The process of making and showing a videotape involves a series of energy transformations. The camera collects light reflected from objects and focused by the lens on the vidicon tube surface inside the camera and converts this light energy into electrical energy. The electrical signal which is then sent to the deck exactly duplicates the areas of light and dark of the objects before the camera; in general, those parts of the signal which duplicate white and light gray areas are higher in voltage than those parts which duplicate black and dark gray areas. Although the image on the vidicon tube exists as a whole, through the scanning process of the camera the image is broken down into 525 horizontal lines; the scanning beam of the camera reads across each horizontal line from left to right producing a continuously varying electrical signal. The microphone converts sound waves into an electrical signal which also continuously varies as the sound waves vary.

The function of the deck is to convert these electrical signals from camera and microphone into electromagnetic energy which can be recorded on tape or to con-

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vert the electromagnetic signal from the videotape back into electrical signals which can be played back and displayed on a television set. The recording process converts electrical signals to electromagnetic energy while the playback process converts electromagnetic energy to electrical energy. The video heads and the audio head are the components of the deck which help to perform this energy conversion. The video heads, located on opposite ends of a metal bar inside the drum assembly and spinning in a horizontal plane at 1,800 rpm, receive the electrical signal from the camera and produce a magnetic field. The videotape is composed of minute metallic particles which are aligned when in the vicinity of a magnetic field. The electrical signal from the camera is converted to an electromagnetic signal by the video heads and recorded on the tape as changes in magnetic field strength. Because the magnetic field and therefore the alignment of the particles on the tape vary in direct proportion to the electrical signal from the camera, the light and dark information of the original image is still retained on the tape. Audio information is recorded on tape in a similar manner, although the audio head is stationary. A control head is responsible for recording and reading the control track on the tape; the function of the control signal is to maintain the horizontal and vertical stability of the recording so that when it is displayed the picture will not roll or break up into diagonal lines.

Because videotape, as it is threaded past the components of the deck, drops a distance equal to its height from the supply to the take-up reel, it is oriented in a diagonal manner as it comes into contact with the video heads. Equipment with this type of configuration is referred to as helical scan. The video signal is thus recorded on the tape as a series of diagonal lines. The tape is running in a horizontal plane as it reaches the audio and control heads so both of these tracks are recorded on the tape in a horizontal line; the control track is usually along the bottom edge of the tape and the audio track at the top edge. During playback, as the magnetized tape contacts the video and audio heads, the magnetic fields induce in those heads an electrical signal which, again, contains the picture and sound information and varies in direct proportion to the original electrical signals. This electrical signal is then converted to a radio frequency and sent from the deck to the VHF antenna leads of a television receiver.

By tuning the receiver to the channel for which the RF unit in the deck was manufactured, the image and sound on the tape will be displayed on the television set. The television receiver converts the electrical signal from the deck back into light and sound energy containing the same information as was presented to the image and sound gathering devices. Because the electrical signal is linear, the image on the television screen is traced line by line, horizontally, moving from left to right until 525 horizontal lines are traced forming one complete image. This process is the reverse of the one used in the camera. Since 30 complete images are displayed each second, one perceives motion rather than a series of still images.

A recorded videotape can be processed further and used in a wide variety of ways. A tape can be edited, but the procedure does not normally involve a physical splicing process as film does. The editing process for video is electromagnetic in nature and involves the selective re-recording of sections

of the original tapes onto a new tape using two decks, one of which is an editing videotape recorder. Prerecorded tapes may be combined and mixed with other tapes or live camera images or manipulated through the use of video processing systems such as special effects generators, colorizers and keyers.

Although a portable video system is relatively easy to operate, certain procedures and precautions must be observed in order to prevent damage to the equipment and to insure the quality of the recording. The discussion which follows is intended only to supplement and summarize thorough supervised instruction.

#### General Considerations:

- A. Avoid mechanical shock to any component of the system; do not exert any pressure on the head drum cover or assembly.
- B. Do not point the camera at a source of bright light; exposure to excessive light, particularly sunlight, will result in a permanently damaged vidicon tube. Burns will result whether the camera is on or off, connected to the deck or stored on a shelf.
- C. In general, all video connections are keyed; they must be inserted in only one way, and damage can result from improper connection. Connections should not be forced; if connectors do not fit together easily, it is an indication that the operator is making an error.
- D. Cleaning of any part of the system should not be attempted unless specific instruction in the proper procedure has been received; ~~improper~~ proper methods can damage the equipment.
- E. Do not change the position of the function lever rapidly and wait until the heads are at rest and the motor has completely stopped. If this is not observed the tape and machine may be damaged.
- F. Recheck tape threading; incorrect threading will prevent proper recording.
- G. Make a short test recording before proceeding to determine that the system is functioning properly.

#### Tape:

Videotape consists of minute metal particles on a plastic backing; recordings are made on one side of the tape in one direction only. Physical damage to the tape such as stretching or tearing will prevent proper recording and may damage the machine; dirt and grease on a tape will adversely affect recording and may cause components of the deck to become dirty. Videotape may be erased and reused provided that the tape is not physically damaged or dirty; damaged tape should be discarded. The format of the machine refers to the width of the tape which can be used on the deck;  $\frac{1}{2}$ " machines use  $\frac{1}{2}$ " tape. Currently,  $\frac{1}{2}$ " portable reel to reel equipment will accommodate a maximum tape time of 30 minutes.

#### Camera:

The vidicon tube of a camera must be light sensitive in order to operate; however the camera must always be protected from exposure to excessively bright

light. A camera must never for any length of time be pointed at the sun or its reflections or at incandescent or fluorescent lights; this is true whether the camera is on or off, connected to the deck or in storage. Keep the lens closed or a body cap on the camera when storing and transporting and avoid pointing the camera at light sources while taping. Exposure to excessively bright light will burn the vidicon tube and result in permanent damage.

Most cameras are designed for use with a C mount zoom lens; if any other lens is substituted, be sure that the physical construction of the mount will not contact the vidicon tube surface. Other lenses may also produce vignetting. Most cameras also contain an internal, general purpose microphone; the sound and picture are both carried from the camera to the deck on one ten pin cable. If an external microphone is used it may be plugged into the mike input of the portapack deck; this automatically disconnects the internal microphone. Microphones can be omni-directional, sensitive to sounds from all directions, or uni-directional, sensitive to sounds in front of the mike. The viewfinder of the camera will display the image of a prerecorded tape played back on the portapack.

The standard zoom lens has three controls. The f-stop ring or aperture control limits the amount of light entering the camera. The zoom ring allows adjustment from telephoto to wide angle shots, and the focus ring adjusts the sharpness of the image.

#### Deck:

The deck contains inputs for a camera, a power source and an external mike; it contains outputs for the RF unit connection to a television receiver and an earphone connection which permits the monitoring of audio on a prerecorded tape which is being played back on the portapack. The deck contains the function lever to put the deck into record, forward, rewind and fast forward. The tracking control allows for minor picture adjustments on playback only. The TV/Camera selector in the TV position allows for recordings off-the-air when used with the appropriate monitor/receiver; when recording with a camera and when playing back a tape this switch should be in the Camera position. The camera and power inputs are both keyed; the ten pin camera cable and the four pin power cable can be connected in one way only. Improper connections will cause damage. The battery level meter reflects the amount of power contained in the battery and should remain in the white or charged area when the deck is operated. Power is consumed by the video system whether the deck is in standby or record position.

#### Power:

The portapack can be operated with an AC power adapter or with a battery. The AC power adapter converts 110 AC house current to the DC voltage needed by the system; the AC adapter must be plugged into a wall outlet and the power input on the deck simultaneously and prevents portable operation but assures a constant power supply.

Most portapacks come equipped with a gel cell battery which is located inside the deck case; it connects to the deck internally and can be recharged with the appropriate battery charger. Another option is the rechargeable nicad



battery pack which is external, has its own carrying case and connects to the deck through the four pin power input. It is important to remember that when batteries are being recharged they must never be connected to the deck or severe damage will result. If the four pin input is used, the connection must be made correctly in only one way or damage will result. If the batteries are discharged and not supplying enough power, no recording can be made; the meter on the deck should be checked frequently.

#### Receiver:

The recorded tape can be played back on the portapack deck and viewed on a television receiver. The RF unit is located inside the deck housing and is made for a specific channel; it connects to the VHF antenna leads of the receiver through the RF output on the back of the deck. The television must be tuned to the specified channel for proper picture and sound display. The camera viewfinder will also display the taped image and sound may be monitored through an earphone connected to the output of the deck. This is recommended for testing purposes only.

#### Assembly:

- Confirm:      Camera: body cap is on or lens is closed  
              Power: if AC adapter is used, it is unplugged and turned off  
                      if external battery is used, it is not being charged and  
                      is not plugged into wall outlet or charger  
              Deck: is in stop mode and TV/Camera switch is in Camera position
- Connect:      Camera: connect to deck with the ten pin cable; make sure connector  
                      is oriented properly with keys aligned. Insert and do not  
                      force or twist.  
              Power: if AC adapter or external battery is used, connect the four  
                      pin connection to the power input on the deck. Observe  
                      all above precautions.  
              Receiver: if you wish to view a tape while you are recording it,  
                      connect the RF output of the deck to the VHF antenna  
                      leads of the set, turn on the set and tune to the pro-  
                      per channel. This is normally not possible during field  
                      recording.  
              Microphone: if an external mike is used, connect mike jack to mike  
                      input on deck

Recheck all connections.

Thread tape onto deck and check threading with diagram on inside front cover of deck.

Place lens on camera or open lens, first making sure that the camera is not pointing at a light source.

Plug in the AC power adapter, if used, and turn it on.

Operation:

**Recording:** To place deck in standby mode move the recording lever to the left position and hold while moving the function lever from stop to forward; release record lever and it will remain in the left position. In the standby mode the image will appear on the viewfinder of the camera but no recording will be made; lens adjustments and camera position can be chosen. Keep in mind that this mode consumes battery power.

To begin taping depress and release the trigger on the camera grip or the small button on the front of the camera; both image and sound are being recorded.

To stop taping depress and release trigger and reels will stop moving; system will return to standby mode.

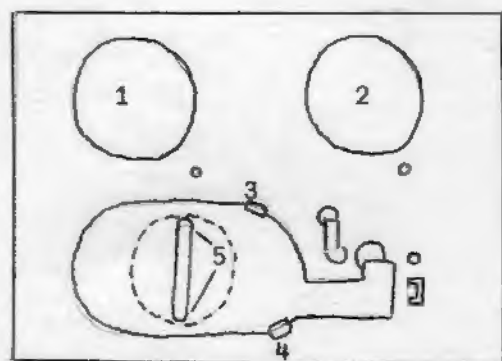
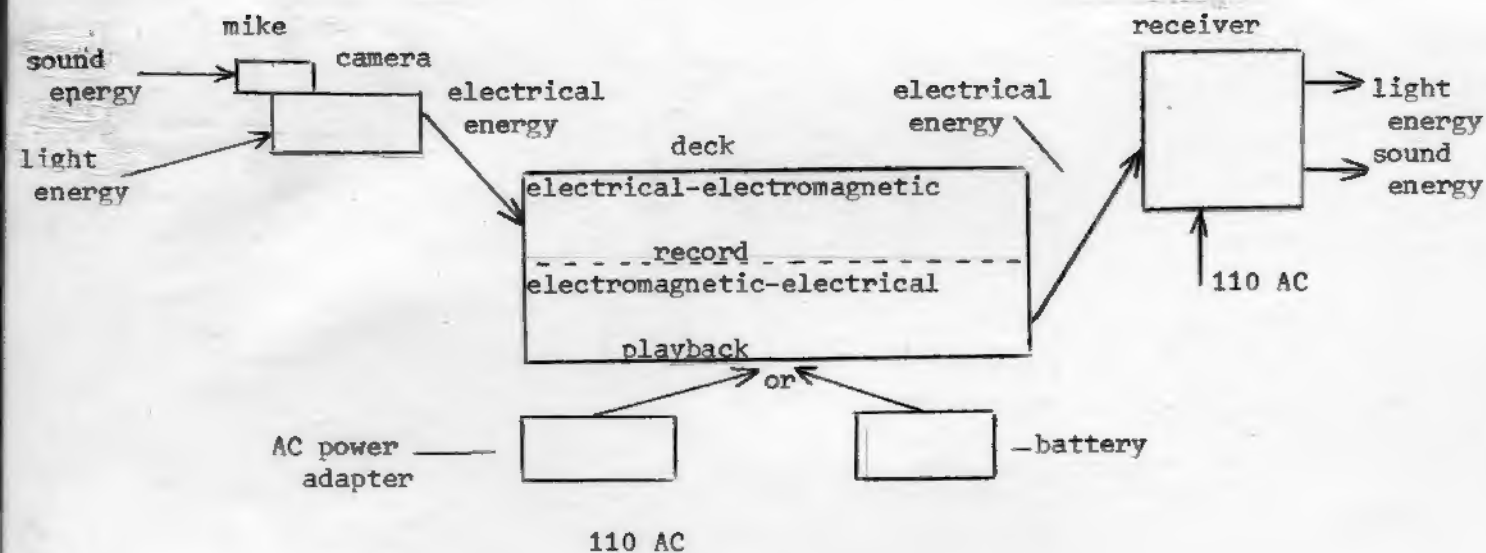
**Testing:** To playback the tape for test purposes to insure that the system is operating properly, move function lever from forward position to stop position; do not touch the record lever because it will return to the right side position when the function lever is moved. Wait until the heads have stopped rotating and the motor has come to a complete stop, then move the function lever to rewind. When tape has reached desired position move function lever to stop and ~~wait until heads stop rotating~~. Move function lever to forward but do not engage record lever or tape will be erased.

To rewind: if a tape is completely on the take-up reel, tape must be re-threaded from take-up to supply reel just as in the recording process. Do not go directly from take-up to supply reel or severe tape damage will result. Put function lever in stop position before re-threading. After tape is re-threaded move function lever to rewind.

To fast forward: move function lever to fast forward position; to stop mode, return lever to stop and wait until heads and motor are stopped before putting deck into another mode.

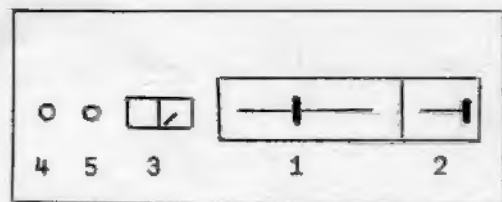
**Viewing:** A prerecorded tape may be played back on a portapack deck onto a conventional television receiver if the deck has an RF unit; RF output is connected to VHF antenna leads of the set and set is tuned to appropriate channel.

If a studio deck and monitor system are available, this is the preferred method of viewing. Because the signals are not converted to radio frequency signals, this type of system reflects with greater accuracy the quality of the recorded material.



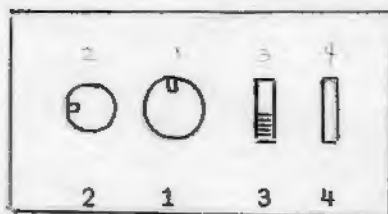
Top

1. supply reel
2. take-up reel
3. erase head
4. audio and control heads
5. video heads



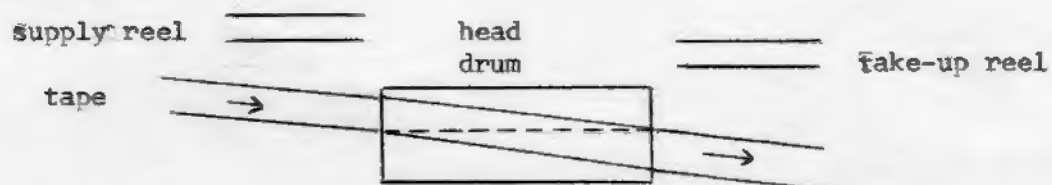
Front

1. function lever
2. record lever
3. battery meter
4. microphone input
5. earphone output



Side

1. camera input
2. power input
3. TV/Camera switch
4. tracking control



1. audio track
2. video track
3. control track